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Submission date: 07-Sep-2021 11:27AM (UTC+0700)

Submission ID: 1642838655

File name: Sumarno_2021_IOP_Conf._Ser._Mater._Sci._Eng._1098_052102.pdf (699.07K)

Word count: 2901

Character count: 14924

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To cite this article: S Sumarno *et al* 2021 *IOP Conf. Ser.: Mater. Sci. Eng.* **1098** 052102

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Knowledge based information system for detecting early eye diseases

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Abstract. The eyes are very important senses in human life. If the eyes experience interference, it will be fatal to human life. Although each type of eye disease has its own specific characteristics and symptoms, early detection with a deeper recognition of eye disease symptoms should be done. Knowledge-based information systems are systems that attempt to convert human knowledge into computers so that computers can solve problems as is usually done by experts. produce conclusions or goals. The aim of this study is to design applications for early detection of fourteen types of eye diseases. This detection uses a knowledge-based system that uses the Forward Chaining method. This study produced an output in the form of the possibility of the disease the user suffered based on fifty-three selected symptoms. This system indicates how much confidence the user has in the symptoms of possible eye diseases.

1. Introduction

As is known, the eye is a very important thing in human life to be seen. With human eyes can enjoy the beauty of nature and can interact with the surrounding environment well. If the eyes experience interference, it will be fatal to human life. Thus, the eyes are members of the body that need to be maintained health. With the rapid development of information technology in the medical field today, it has utilized information technology to help improve better services. The work of doctors who are very busy, so that technology and medical experts collaborate to produce the field of computer-based systems and are used to help patients know the disease from an early stage and experts in diagnosing various diseases such as heart, kidney, stroke, cancer, teeth, skin, up to the eyes.

1.1. Knowledge-based information system

Knowledge-Based Information System (expert system) is a computer application program that seeks to mimic the reasoning process of an expert in solving specification problems. Data stored in the database will accurately inform patient complaints and can conclude the type of eye disease suffered by the patient. In general, an Expert system is a system that seeks to adopt human knowledge into computers, so that computers can solve problems as is usually done by experts. A good expert system is designed to solve certain problems by imitating the work of experts. With this expert system, being able to solve a problem that is quite complicated can actually only be solved with the help of experts. For experts, this expert system will also help its activities as a very experienced assistant. Transfer expertise from an expert to a computer and then transfer it back to someone who is not an expert. This system process requires four activities, namely (1). Additional knowledge (2). Knowledge



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representation (to computers), (3). Conclusion of knowledge, (4). and transfer of knowledge to users. Knowledge stored on a computer is called a knowledge base.

There are two types of knowledge, namely facts and procedures (usually in the form of rules). One feature that must be possessed by an expert system is the ability to think. If expertise is stored as a knowledge base and a program is available that can access the database, then the computer must be programmed to make conclusions. This inference process is packaged in the form of motor inference (inference machines). Most commercial expert systems are made in the form of rule-based systems, where knowledge is stored in the form of rules. The rules are usually in the form of IF-THEN. Another feature of the expert system is the ability to provide advice or recommendations. This ability distinguishes expert systems from conventional systems. Motor Inference Engine inference is the part that contains the mechanism of thinking functions and systems reasoning patterns used by an expert. This mechanism will analyze a particular problem and then find the best answer or conclusion

1.2. Forward chaining

One technique that can be used in inference, namely. Forward Chaining, matching facts or statements starting from the left (IF first). In other words, reasoning starts from the facts first to test the truth of the hypothesis or also called forward reasoning. This model is different from conventional programming, for example rules do not have to be in a certain order. An example of a rule based system is as follows,

- R1 = If A and C Then E
- R2 = If D and C Then H
- R3 = If B and E Then F
- R4 = If B then C
- R5 = If F Then G.

The basis of rules in this problem is a collection of rules that are interconnected with each other. These rules or rules are represented in the form of IF-Then conditions. This statement links the premise (IF) and the conclusion part (Then). If the premise in the rules of production can have more than a proposition, the propositions are linked using the logical AND operator. Expert system model for diagnosis of eye diseases in humans using the forward chaining method. In Figure 1 it is shown that the data is taken from existing references about various types of eyes and existing problems that are stored in a knowledge database called the base, while the facts are the facts that exist due to eye diseases that are Correlated with a database of expert knowledge or references that have been taken, for the use of rules, because this knowledge system uses the concept of backward system theory.

There are fourteen types of eye disease, (1). Dacryocystitis is an infection of the lacrimal sac (2). Glaucoma, is a type of eye disease that gradually causes eye vision to be reduced. (3) Cataract, is a type of eye damage that causes webbed and nearsighted lenses. (4). Conjunctivitis, is inflammation of the conjunctiva. (5) Vernal conjunctivitis, caused by allergic factors. (6) Endophthalmitis, is inflammation of the entire inner eye lining. (7) Blepharitis, is inflammation of the eyelids due to excessive oil production from the oil glands. (8) Corneal ulcer, is an infection of the external cornea. (9) Episcleritis, is inflammation that occurs between the sclera and conjunctival tissue in the eye. (10) Swelling of the Eye Socket. (11). Orbital cellulitis as a serious infection involving muscle and fat located in the orbit. (12) Keratomalasia, (Xeroftalmia, Xerotic Keratitis) is a condition in which the cornea becomes dry and cloudy due to lack of vitamin A. (13). Herpes simplex infection in the cornea is one of the causes of corneal damage. (14). Shingles (HZ) is a reactivated form of the varicella zoster virus (VZV), the same virus responsible for chickenpox.

Published research results are very important as a rationale and consideration in conducting research. Computer-based information systems for example by Peng Zhang, Leyang Xue, An Zeng, Predictability of diffusion-based recommendation systems [1], and by Kajal Jaisinghani, Maharashtra, Artificial Intelligence Using Forward Chaining and Backward Chaining [2] as well as several other research examples. Forward Chaining methods such as Kurnia Muludi, Radix Suharjo, Admi Syarif, Fitria Ramadhani [3], then by B. Herawan Hayadi, Adolf Bastian, Kasman Rukun, Nizwardi Jalinus,

Yaslinda Lizar, Asriwan Guc [4], also by many others. Forwarding Chaining Research Method, 2019 by Atikah Ari Pramesti, Riza Arifudin, Endang Sugiharti and by Jamaludin, Haryanto, Yulia Karlina Hasim, Dental Research Expert System and diagnosis using Android-based Forward Chaining [5,6], 2018 as well as by I Santosa, L Romla, S. Herawati, Diagnosis of Expert System for Cataract Eye Using Fuzzy [7], in this study discusses building a knowledge-based application system that can link the initial disease types with the forward chaining method. In this study there are four types of diseases, Dacryocystitis, Glaucoma, Cataract, Conjunctivitis, Conjunctivitis Vernalis, Endophthalmitis, Blepharitis, Corneal Ulcer, Episcleritis, Socket Eye Swelling, Orbital Cellulitis, Keratomalasia, Herpes simplex in reminder and methods used in Forward Chaining.

2. Methods

The method used in designing this information system consists of four stages, namely, literature study, problem formulation, problem solving, objectives and conclusions. Literature study is reviewing relevant literature, gathering data and information, analyzing problems and designing. Data is taken from reference books and journals. This data will be processed as input data and will become a knowledge database. Input data in the form of fourteen types of eye diseases and fifty-three types of symptoms, along with their outputs then the results of diagnoses and recommended solutions.

At the design stage using Chaining inference forward, the data used is shown in table 1 and the type of disease uses the symptom code G_01 to G_53 as follows:

G_01 Fever, G_02 Ejecting pus in the corner near the nose, G_03 Excessive tears, G_04 Swollen lower eyelid, G_05 Red eye, G_06 Eye aches / aches, G_07 When Looking at a Light Source, a rainbow appears around the light source, G_08 Headache, G_09 Swollen Eyes, G_10 Blurred vision gradually becomes normal, G_11 Flashes continuously, G_12 Blurred Vision, G_13 Visual acuity is reduced, G_14 G_14 Contrast sensitivity disappears, G_15 Blinding light, G_16 See the circle around the light, G_17 Objects that are seen are yellowish, G_18 Change glasses often, G_19 Double vision in one eye, G_20 Eyes excrete, G_21 The eyes feel itchy, G_22 Watery eyes, G_23 Sensitive to light, G_24 A scab forms on the eyelid when you wake up in the morning, G_25 Vision loss, G_26 Eyeballs festering, G_27 Eyes feel hot, G_28 There is a wound on the eyelid, G_29 Eyelashes fall out, G_30 When I wake up my eyelids are hard to open, G_31 Disturbance of vision, G_32 On the cornea visible yellowish white pus spots, G_33 Inflammation of a small portion of the eyeball, G_34 Part of the eye area is rather prominent, G_35 Yellow eyes, G_36 The shape of the cornea protrudes like a cone, G_37 Eyes have nearsightedness, G_38 Occurs more than a few days and the eyes feel more severe pain, G_39 G_39 Eyes stand out, G_40 Reduced Eye Movement, G_41 Swollen eyelids, G_42 Swollen eye ball, G_43 Early experience night blindness, G_44 The eyes feel dry, G_45 Presence of wrinkles, G_46 Turbidity and softening of the cornea, G_47 In the conjunctiva visible dry and foamy sediments that are silvery gray, G_48 Corneal swelling, G_49 Open wound formation, G_50 Formation of permanent scar tissue, G_51 Disappeared when the eyes are touched, G_52 Increased pressure inside the eyeball, G_53 Has permanent glaucoma.

Table 1. Knowledge database of eye diseases.

Code	Type of eye disease
P_01	<i>Dacryocystitis</i>
P_02	<i>Glaukoma</i>
P_03	<i>Cataract</i>
P_04	<i>Konjungtivitis</i>
P_05	<i>Konjungtivitis Vernalis.</i>
P_06	<i>Endoftalmitis</i>
P_07	<i>Blefaritis</i>

Table 1. Cont.

<i>P_08</i>	<i>Ulkus Kornea</i>
<i>P_9</i>	<i>Episkleritis</i>
<i>P_10</i>	<i>Swelling of the Eye Socket</i>
<i>P_11</i>	<i>Orbital Sellulitis</i>
<i>P_12</i>	<i>Keratomalasia</i>
<i>P_13</i>	<i>Herpes simplex infection in the cornea</i>
<i>P_14</i>	<i>Herpes Zoster Infection</i>

3. Results and discussion

The decision tree produced in this study can be seen in Figure 1, and is used as a reference in formulating production rules, as well as all production rules in accordance with the inference engine.

3.1. Forward chaining rules

The inference engine used by researchers is forward Chaining, by looking for the rules as in Figure 1, the system will conclude to find one of the correct antecedents (hypothesis or IF-THEN clause). When the production rules are found the decision-making machine as in the example in Figure 3b or the consequence (THEN-clause) produces new additional information from the database provided. The database used is the eye disease type database (Table 1) and the symptom database G_01 to G_53, then the machine will repeat this process until the target is found.

In the decision tree of the production rules of the Forward Chaining Method, in this case the four branches of the search tree are shown with fifty-three symptom features and fourteen types of eye diseases. Where each branch will produce symptoms (G), G_01 Fever, G_02 The eye secretes pus around the nose, G_03 Excessive tears, G_04 Swollen lower eyelid, G_05 Red eye, G_06 Eye pain, the system defines the type of eye disease Dacryocystitis as shown in the figure 3 (conclusion). For the seconds earch G_12 Blurred vision G_13 Visual acuity is reduced, G_14 contrast sensitivity disappears,

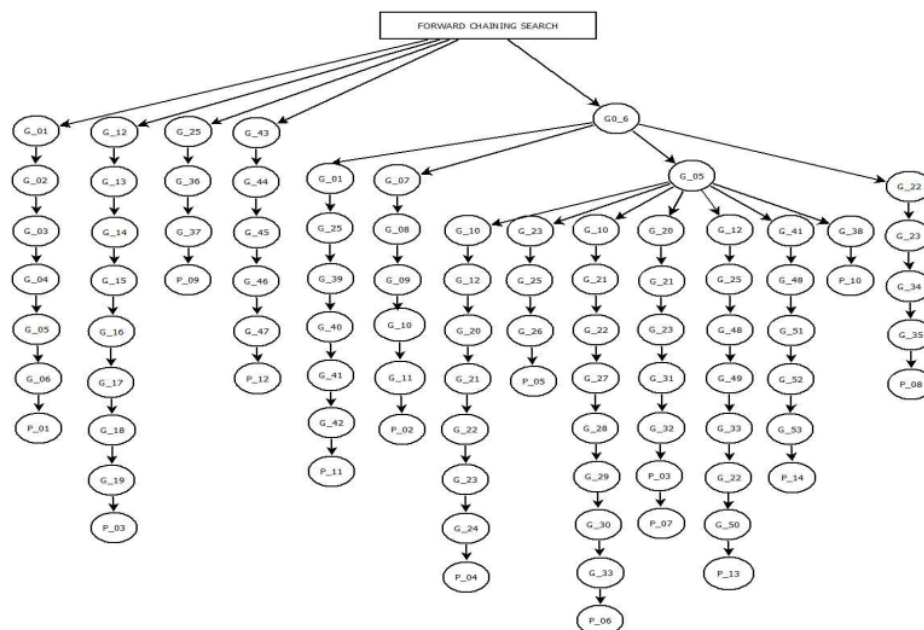


Figure 1. Decision tree with forward channing search.

G_15 Blinding light, G_16 See the circle around the light, G_17 Objects that look yellowish, G_18 often replace glasses, G_19 double vision, G_03 Overblown eyes then the system defines cataract eye disease, and so on.

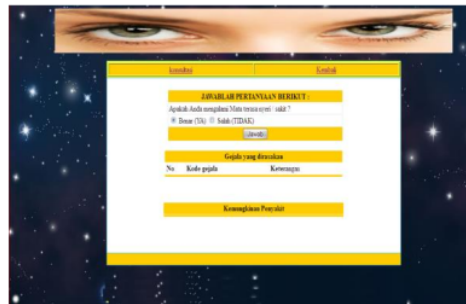


Figure 2a. User test results (the machine receives questions from users).

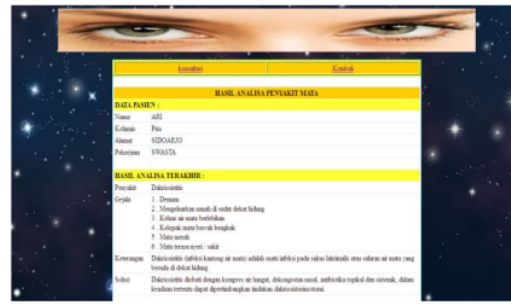


Figure 2b. User test results (how the decision engine is made).

In Figure 2a and Figure 2b is one example given in the study so that shows that the knowledge-based system functions as expected. One of the symptoms produced is first the patient's body has a fever, the patient's eyes ooze pus around the nose, then the tears come out excessively, the eyelids at the bottom experience swelling, the eyes are sore and red, so the system produces a diagnosis of "Dacryocystitis" with recommended given is treating patients by compressing warm water, nasal decongestants, topical and systemic antibiotics.

4. Conclusion

Based on the description that has been submitted, it can be concluded

- That designing a computer-based knowledge information system in determining the type of eye disease and its symptoms can use forward chaining and is done by designing production rules so that it is easier to make a decision tree for the type of disease.
- The design of information systems in medicine is very interesting and has been made by many previous studies in the diagnosis of various diseases. In this study, the authors want to help the public to know the symptoms of eye diseases and the types of eye diseases of patients.
- In this research there are many weaknesses, because there is not much interactive training and expert advice and also presents information as much as fourteen types of eye diseases and fifty-three symptoms.
- It is hoped that future research will be better than this research, on various sides, ranging from methods, continuing training and interaction with experts.

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